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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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09/752,685

01/03/2001

Shane J. Trapp

M4065.0369/P369

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24998

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06/07/2002

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EXAMINER

PHAM, THANHHA S

ART UNIT

PAPER NUMBER

2813

DATE MAILED: 06/07/2002

7

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/752,685

Applicant(s)

TRAPP, SHANE J.

Examiner

Thanhha Pham

Art Unit

2813

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 26 March 2002.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-25, 36-46 and 64-70 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-25, 36-46, 64-70 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s) _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

DETAILED ACTION

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

1. Claims 2, 13-14, 36-46, and 64-70 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

With respect to claim 2,

It is not clear how a self-aligned contact opening is defined – how an opening is defined as a self-aligned contact opening?

With respect to claim 13,

Lines 1-3, it is not clear where “sidewall spacers”, “a gate stack” come from and are actually located. It is not clear how “a gate stack” and “sidewall spacers” are formed in the method of forming an opening in an insulative layer as being claimed.

With respect to claim 14,

Lines 1-3, it is not clear where “side wall spacers”, “a gate stack” come from and are actually located. It is not clear how “a gate stack” and “side wall spacers” are formed in the method of forming an opening in an insulative layer as being claimed.

With respect to claim 36,

It is not clear how to form a pair of adjacent gate stacks in said insulative film and forming sidewall spacers on side walls of said adjacent gate stacks

Art Unit: 2813

With respect to claim 37,

It is not clear how a self-aligned contact opening is defined – how an opening is defined as a self-aligned contact opening?

With respect to claim 43,

“said contact opening” lacks of antecedent basis

With respect to claim 64,

Lines 1-2, “a contact opening in an insulative layer between adjacent gate stacks formed over a substrate” renders the claim indefinite. It is not clear which element, “a contact opening” or “an insulative layer”, is located between adjacent gate stacks. And what are formed over a substrate -- “a contact opening” or “an insulative layer” or “adjacent gate stacks”?

Lines 6-8, “to form a self-aligned contact opening in said insulative layer between said gate stacks without an etch stop” renders the claim indefinite. It is not clear what is formed between said gate stacks -- “a self-aligned contact opening” or “said insulative layer”? In addition, “said gate stacks” lacking of antecedent basis should be changed to “said adjacent gate stacks”.

Line 10, it is not clear where “said opening” comes from or locates at. It is not clear that “said opening” refers back to “a contact opening” (line 1 of claim 64) or “a self-aligned contact opening” (line 6-7 of claim 64)

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1, 3, 8-12, 15, as being best understood, are rejected under 35 U.S.C. 102(b) as being anticipated by Smolinsky et al ["Reactive Ion Etching of Silicon oxides with Ammonia and Trifluoromethane, the Role of Nitrogen in the Discharge", J. Electrochem. Soc.: Solid-State Science and Technology, Vol 129 No. 5, May 1982, pp1036-1039].

Smolinsky et al discloses the claimed method of forming an opening in an insulative layer formed over a substrate in a semiconductor device comprising etching said insulative layer with an etchant composition consisting essentially of ammonia and at least one of fluorocarbon (CHF₃ and NH₃) using plasma etch and photoresist mask so as to form said opening without forming an etch stop.

3. Claims 1, 3, 8-12, as being best understood, are rejected under 35 U.S.C. 102(b) as being anticipated by Levinstein et al [US 4,985,373].

Levinstein et al, fig 1 and col 1-6, discloses the claimed method of forming an opening in an insulative layer formed over a substrate in a semiconductor device comprising etching said insulative layer (14,15) with an etchant composition consisting

Art Unit: 2813

essentially of ammonia and at least one of fluorocarbon (CHF₃ and NH₃, col 6 lines 36-37) using plasma etch so as to form said opening without forming an etch stop.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 1-25, 34-46 and 64-70, are rejected under 35 U.S.C. 103(a) as being unpatentable over Park [US 6,103,137] in view of Smolinsky et al ["Reactive Ion Etching of Silicon oxides with Ammonia and Trifluoromethane, the Role of Nitrogen in the Discharge", J. Electrochem. Soc.: Solid-State Science and Technology, Vol 129 No. 5, May 1982, pp1036-1039].

Park et al, figs 3's-4 and col 1-4, discloses a method of forming a self-aligned contact opening located in an insulative layer and between adjacent gate stacks formed over a substrate in a semiconductor device comprising contacting said insulative layer with a plasma etchant mixture consisting of fluorocarbon (e.g. CHF₃, C₄F₈, CH₂F₂) so as to form a self-aligned contact opening in said insulative layer and between said gate stacks without an etch stop (figs 3F-3G).

With respect to claims 1-3, 8-14, 18-19, 36-38, 42-43, 46, Park et al fails to teach using the plasma etchant mixture essentially consisting of ammonia and at least one fluorocarbon – a combination of ammonia and fluorocarbon selected from the group

Art Unit: 2813

consisting of C₄F₈, C₄F₆, C₅F₈, CF₄, C₂F₆, C₃F₈. Smolinsky et al teaches using the plasma etchant mixture essentially consisting of the fluorocarbon and ammonia by adding ammonia to the fluorocarbon etchant to improve etching selectivity of the insulative material in forming an opening – without damaging underlying layer. It would

have been obvious for those skilled in the art to combine the teaching of Smolinsky et al to add ammonia to the plasma etchant mixture of the process of Park et al to form the plasma etchant mixture essentially consisting of fluorocarbon and ammonia to provide a better controlled etching process.

With respect to claims 64 and 69, Park et al fails to teach: **(1)** using the plasma etchant mixture essentially consisting of ammonia and at least one fluorocarbon at temperature within the range of about -50 to 80°C to form the self-aligned contact opening with further forming a protective layer over sidewall spacers which have been formed over the gate stacks; and **(2)** depositing a conductive plug inside said opening such that said conductive plug separated from said side wall spacers by said protective layer. Regarding to **(1)**, Smolinsky et al teaches using the plasma etchant mixture essentially consisting of the fluorocarbon and ammonia by adding ammonia to the fluorocarbon etchant to improve etching rate and etching selectivity of the insulative material in forming an opening. It would have been obvious for those skilled in the art to combine the teaching of Smolinsky et al to add ammonia to the plasma etchant mixture of the process of Park et al to form the plasma etchant mixture essentially consisting of fluorocarbon and ammonia as being claimed to provide a better controlled etching process. With combination of Smolinsky et al to the process of Park et al, the protective

Art Unit: 2813

layer containing nitrogen would be resulted over the sidewall spacers on the gate stacks of structural device of Park et al. Although Smolinsky et al and Park et al are silent about the temperature for etching the insulative layer, the range temperature of about -50 to 80°C for etching the insulative layer is considered to involve routine optimization

while has been held to be within the level of ordinary skill in the art. As noted in In re Aller, the selection of reaction parameters such as temperature and concentration would have been obvious. Regard to (2), it would have been obvious for those skilled in the art to depositing a conductive plug inside the self-aligned contact opening formed by Park et al in view of Smolinsky et al to form conductive path for operating the device.

With respect to claim 19, using the fluorocarbons comprising CF₄, CHF₃ and C₂H₂F₂ is well-known in the art for etching the insulative layer. The selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co., Inc. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945) "Reading a list and selecting a known compound to meet known requirements is no more ingenious than selecting the last piece to put in the last opening in a jig - saw puzzle." 65 USPQ at 301.). It would have been obvious for those skilled in the art to use the fluorocarbons comprising CF₄, CHF₃ and C₂H₂F₂ in the process of Park et al in view of Smolinsky et al to etch the insulative layer for form self-aligned contact opening as being claimed.

With respect to claims 4-7, 15-17, 20-25, 39-41, 44-45, 64-70, claimed ranges of temperature, flow rates, flow rate ratios in the etching steps are considered to involve routine optimization while has been held to be within the level of ordinary skill in the art.

As noted in *In re Aller*, the selection of reaction parameters such as temperature and concentration would have been obvious.

"Normally, it is to be expected that a change in temperature, or in concentration, or in both, would be an unpatentable modification. Under some circumstances, however, changes such as these may be impart patentability to a process if the particular ranges claimed produce a new and unexpected result which is different in kind and not merely degree from the results of the prior art...such ranges are termed "critical ranges and the applicant has the burden of proving such criticality... More particularly, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation."

In re Aller 105 USPQ233, 255 (CCPA). See also *In re Waite* 77 USPQ 586 (CCPA 1948); *In re Scherl* 70 USPQ 204 (CCPA 1946); *In re Irmischer* 66 USPQ 314 (CCPA 1945); *In re Norman* 66 USPQ 308 (CCPA 1945); *In re Swenson* 56 USPQ 372 (CCPA 1942); *In re Sola* 25 USPQ 433 (CCPA 1935); *In re Dreyfus* 24 USPQ 52 (CCPA 1934).

5. Claims 2, 4-7, 13-14, 15-25, 36-46 and 64-70, as being best understood, are rejected under 35 U.S.C. 103(a) as being unpatentable over Levinstein et al [US 4,985,373] in view of Tan et al [US 6,140,168].

Levinstein et al substantially discloses the claimed method for forming an opening in an insulative layer comprising etching the insulative layer using an etchant composition consisting essentially of ammonia and at least one fluorocarbon.

Levinstein et al does not expressly teaches forming said opening as a self-aligned contact opening located in the insulative layer and between adjacent gate stacks wherein the adjacent gate stacks includes sidewall spacers and said etching does not remove the sidewall spacers.

However, forming such a self-aligned contact opening between such adjacent gate stacks is well-known in the art. See Tan et al reference as an evidence. It would have been obvious for those skilled in the art to combine the teaching of Tan et al to the process of Levinstein et al to form the self-aligned contact opening as being claimed as a designed choice of a device.

With respect to claims 4-7, 15-17, 20-25, 39-41, 44-45, 64-70, claimed ranges of temperature, flow rates, flow rate ratios in the etching step are considered to involve routine optimization while has been held to be within the level of ordinary skill in the art. See *In re Aller* 105 USPQ233, 255 (CCPA). See also *In re Waite* 77 USPQ 586 (CCPA 1948); *In re Scherl* 70 USPQ 204 (CCPA 1946); *In re Irmischer* 66 USPQ 314 (CCPA 1945); *In re Norman* 66 USPQ 308 (CCPA 1945); *In re Swenson* 56 USPQ 372 (CCPA 1942); *In re Sola* 25 USPQ 433 (CCPA 1935); *In re Dreyfus* 24 USPQ 52 (CCPA 1934).

6. Claims 1-25, 36-46 and 64-70, as being best understood, are rejected under 35 U.S.C. 103(a) as being unpatentable over Tan et al [US 6,140,168] in view of Ding et al [US 5,814,563] and Levinstein et al [US 4,985,373].

Tan et al, figs 1's and col 1-4, discloses a method for forming a self-aligned contact opening (124, fig 1D) in an insulative layer (114b) formed over a substrate comprising steps:

Art Unit: 2813

providing the substrate (100, fig 1A) comprising adjacent gate stacks being formed thereon, the adjacent gates stacks comprising opposed side wall spacers (108) which have been formed over the adjacent gate stacks;

forming the insulative layer (114, fig 1B) over the substrate, the adjacent gate stacks and the side wall spacers which have been formed over the adjacent gate stacks; and

forming a patterned photoresist mask layer (116, fig 1B) over said insulative layer;

contacting and etching the insulative layer through an aperture (120, fig 1C-1D) in the patterned photoresist mask layer, using a plasma etchant mixture comprising fluorocarbon (CHF_3 and CF_4 , col 3 lines 42-55) so as to form the self-aligned contact opening (124, fig 1D) in the insulative layer, the self-aligned contact opening being located between the adjacent gate stacks and the opposed side wall spacers aligning the self-aligned contact opening to the substrate; and

removing the patterned photoresist mask layer after said contacting and etching.

Tan et al does not teach: **1)** using the plasma etchant mixture essentially consisting of ammonia and said fluorocarbon to form the self-aligned contact opening at a temperature of about -50 to 80°C without an etch stop and further forms a protective layer over the opposed side wall spacers of the adjacent gate stacks; and **2)** depositing a conductive plug inside said self-aligned contact such that said conductive plug is separated from said side opposed side wall spacers by said protective layer.

Art Unit: 2813

Regarding to 1), Ding et al teaches using ammonia in addition to fluorocarbon for plasma etching the insulative layer at a temperature of about -50 to 80°C with a high etch rate and an improved etch selectivity. Ding et al also teaches using the plasma etchant mixture comprising fluorocarbon and ammonia would form an opening with a protective layer being formed on side wall of the opening. Levinstein et al shows using the plasma etchant essentially consisting of fluorocarbon and ammonia is conventional and well-known in the art for etching the insulative layer. It would have been obvious for those skilled in the art to combine the teaching of Ding et al and Levinstein et al to the process of Tan et al to use the plasma etchant mixture essentially consisting of ammonia and said fluorocarbon to etch the self-aligned contact at the temperature of -50 to 80°C without an etch stop. In addition, those skilled in the art would recognize that combination of the process of Tan et al in view of Ding et al and Levinstein et al will form a protective layer over the opposed side wall spacers in the self-aligned contact opening.

Regarding to 2), depositing the conductive plug inside the self-aligned contact opening is well-known in the art for forming electrical connection in a semiconductor device. In addition, Tan et al teaches forming a self-aligned contact opening is for forming electrical connection between source/drain region and metal layer [see col 2 lines 15-23). It would have been obvious for those skilled in the art to have limitation 2) in the process of Tan et al in view of Ding et al and Levinstein et al for forming the conductive plug in a semiconductor device to provide electrical connection between

Art Unit: 2813

source/drain region to certain location of the semiconductor device to operate the device.

With respect to claim 19, using the fluorocarbons comprising CF₄, CHF₃ and C₂H₂F₂ is well-known in the art for etching the insulative layer. The selection of a known material based on its suitability for its intended use supported a *prima facie* obviousness determination in *Sinclair & Carroll Co., Inc. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). "Reading a list and selecting a known compound to meet known requirements is no more ingenious than selecting the last piece to put in the last opening in a jig - saw puzzle." 65 USPQ at 301.).

With respect to claims 4-7, 15-17, 20-25, 39-41, 44-45, 65-70, claimed ranges of temperature, flow rates, flow rate ratios in the etching steps are considered to involve routine optimization while has been held to be within the level of ordinary skill in the art. As noted in *In re Aller*, the selection of reaction parameters such as temperature and concentration would have been obvious. *In re Aller* 105 USPQ233, 255 (CCPA). See also *In re Waite* 77 USPQ 586 (CCPA 1948); *In re Scherl* 70 USPQ 204 (CCPA 1946); *In re Irmischer* 66 USPQ 314 (CCPA 1945); *In re Norman* 66 USPQ 308 (CCPA 1945); *In re Swenson* 56 USPQ 372 (CCPA 1942); *In re Sola* 25 USPQ 433 (CCPA 1935); *In re Dreyfus* 24 USPQ 52 (CCPA 1934).

Therefore, one of ordinary skill in the requisite art at the time of invention was made would have used any ranges of temperature, flow rates, flow rate ratio range suitable to the method in process of Tan et al in view of Ding et al and Levinstein et al in order to optimize the process.

7. Claims 1-25, as being best understood, are rejected under 35 U.S.C. 103(a) as being unpatentable over Blalock et al [US 5,286,344] in the view of Ding et al [US 5,814,563] and Smolinsky et al ["Reactive Ion Etching of Silicon oxides with Ammonia and Trifluoromethane, the Role of Nitrogen in the Discharge", J. Electrochem. Soc.: Solid-State Science and Technology, Vol 129 No. 5, May 1982, pp1036-1039].

Blalock et al, figs 1-2 and col 1-9, discloses a method of forming an opening in an insulative layer formed over a substrate in a semiconductor device comprising plasma etching the insulative layer (14, fig 2) with at least one fluorocarbon (CF₄, CHF₃ and CH₂F₂) to form said opening.

Blalock et al does not teaches using a plasma etchant mixture essentially consisting of ammonia and the fluorocarbon etchant.

Ding et al teaches using ammonia in addition to fluorocarbon for plasma etching the insulative layer a better etch rate and a good etch selectivity. Smolinsky et al shows using the plasma etchant essentially consisting of fluorocarbon and ammonia is conventional and well-known in the art for a good profile etching the insulative layer. It would would have been obvious for those skilled in the art to combine the teaching of Ding et al and Smolinsky et al to the process of Blalock et al to use the plasma etchant mixture essentially consisting of ammonia and fluorocarbon to etch the opening with good profile in the semiconductor device without an etch stop, since ammonia can absorb underlying layer to increase etch rate, for reducing production cost.

With respect to claims 4-7, 15-17, 20-25, claimed ranges of temperature, flow rates, flow rate ratios in the etching step are considered to involve routine optimization

Art Unit: 2813

while has been held to be within the level of ordinary skill in the art. See *In re Aller* 105 USPQ233, 255 (CCPA). See also *In re Waite* 77 USPQ 586 (CCPA 1948); *In re Scherl* 70 USPQ 204 (CCPA 1946); *In re Irmischer* 66 USPQ 314 (CCPA 1945); *In re Norman* 66 USPQ 308 (CCPA 1945); *In re Swenson* 56 USPQ 372 (CCPA 1942); *In re Sola* 25 USPQ 433 (CCPA 1935); *In re Dreyfus* 24 USPQ 52 (CCPA 1934).

Response to Arguments

8. Applicant's arguments with respect to claims 1-25, 36-46 and 64-70 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

9. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

Art Unit: 2813

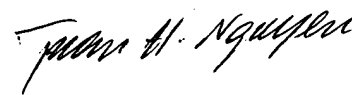
the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanhha Pham whose telephone number is (703) 308-6172. The examiner can normally be reached on Monday-Thursday 8:00 AM - 7:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Chaudhuri Olik can be reached on (703) 306-2794. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-3432 for regular communications and (703) 308-7725 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Thanhha Pham
June 4, 2002



Tuan H. Nguyen
Primary Examiner